Chapter 14
Plumbing Systems

14-1. General

Powerhouse plumbing systems include the following fixtures: water supply piping from in-house treatment plant, storage tank or main at building line, hot water supply, fixture drains and vents, in-house sewage treatment facility, and effluent and sludge pumps. The basic code for design is the National Association of Plumbing-Heating-Cooling Contractors (NAPHCC) 1265, "National Standard Plumbing Code." Refer to TM 5-810-5 which is intended basically for military construction but contains design data that can be useful in powerhouse design. Also, Guide Specification CE-15400 is basically intended for military construction but is a useful reference for powerhouse specifications. Its value as a powerhouse guide specification is limited because of the large quantity of nonapplicable material.

14-2. Fixtures

Fixtures of the system that may be included are listed in Table 14-1. Location, selection, and quantities of fixtures are normally architectural determinations. The mechanical design engineer should be involved in early coordination to assure practical pipe routings and space, facilities consistent with proposed water supplies and sewage treatment, and optimum groupings of fixtures. Tank-type water closets in lieu of flush valves are acceptable in small plants with minimum rest room requirements.

14-3. Water Supply

a. Cold. Cold water from the potable water system (see paragraph 10-5) is provided to all fixtures.

b. Hot. Hot water should be provided to all fixtures listed in paragraph 14-2 except water closets, urinals, drinking fountains, and deluge shower-eyewash. See paragraph 10-5*h*(3) for water heater provisions.

c. Piping. Hot and cold water mains, branches, and risers should normally be sized for 2.4-3.7-m/s (8-12-fps) velocity on flows obtained from fixture-unit flow demand curves in ASME A 31.1. Where flow is continuous in copper lines, the velocity should not exceed 2.1 m/s (7 fps). Continuous temperatures in the range of 60-77°C (140-170°F) for both copper and galvanized steel should be avoided. Individual fixture supply pipes should be 15 mm (1/2 in.) except for 25-mm (1 in.) supplies to flush valve fixtures and deluge shower-eyewash. Shutoff valves should be provided in supply lines to groups of fixtures to facilitate maintenance. Refer to Figure B-8 for typical potable water and sanitary system, Figure B-13 for material schedule, and Chapters 17 and 19.

14-4. Sanitary Piping

a. Drains. Drains from sinks, water closets, standard showers, and lavatories should be routed to the septic tank or other treatment facility. Drains from battery room sink and deluge shower-eyewash are normally routed to the station drainage system. Water coolers may be drained either through sanitary drains or drainage system piping. Sizing should be on fixture unit basis in accordance with ASME A 31.1. Minimum slope on drains 80 mm (3 in.) and smaller is 2 percent. Minimum slope on larger drains is 1 percent with 2 percent preferred. Minimum size of any drain line subject to flow of raw sewage from a water closet is 80 mm (3 in.). (See Figures B-8 and B-13.)

b. Vents. Vents should be provided as required by ASME A 31.1. Termination of vent stacks will normally be above roofs. However, other code termination locations may be acceptable subject to architectural approval. Minimum slopes noted in paragraph 14-4*a* are also applicable to vents.

14-5. Sewage Treatment

a. General. Sewage treatment should generally be combined into one facility for the entire project. The facility will frequently be located away from the powerhouse and coordination will be required. The powerhouse design will usually be limited to collecting and possibly pumping of the raw sewage. When a powerhouse location is most practical, the treatment plant will be included in the powerhouse design. The Corps of Engineers policy is to comply with federal and state sewage treatment requirements. The requirements vary considerably from project to project, in part due to site differences, but to a greater extent from revisions in the federal and state regulations. The design office should obtain the earliest possible approval for proposed facilities at each project to permit an orderly development of piping, pump, and treatment design.

b. Septic tanks.

(1) General. Septic tanks are the preferred treatment facility from design, cost, operation, and maintenance

Table 14-1
Powerhouse Plumbing Fixtures

	Size and Type of Power Plant			
Fixture	2 Unit Unmanned No Visitors	2 Unit Manned No visitor Facilities Moderate Visitor Load	6 Unit Manned Visitor Facilities Moderate Visitor Load	14 Unit Manned Visitor Facilities Heavy
Water Closet	1**	2	9	11
Lavatory	1	2	5	11
Urinal	1	1	6	8
Service Sink	1	1	3	2
Drinking Fountain	1			2
Water Cooler		2	3	7
Fountain Wash			1	1
Eyewash *	1	1	1	1
Safety Shower *	1	1	1	1
Kitchen Sink		1	1	1
Battery Room Sink	1	1	1	1
Shower		1	1	2
First Aid Sink		1	1	1

* Fountain eyewash and safety shower are currently required at all powerhouses with a battery room.

**Figures indicate fixtures installed at four types of existing plants but are for reference only. For new plants, figures should be modified as required to suit personnel and visitor requirements, available water supplies, waste disposal, and other project facilities.

standpoints and should be provided whenever an approved leaching field location is reasonably available. Septic tank effluent discharge directly to tailwater is not permitted.

(2) Location. A septic tank may be located either in the powerhouse or away from the powerhouse. In-house tanks are normally located in mass concrete at a low elevation providing gravity drainage from all fixtures. The location should permit access to the tank through manholes and adjoining space for installation and servicing of effluent pumps, sludge pumps, and chlorinating equipment.

(3) Design. Septic tank design and chlorination equipment should conform to state code requirements for the state in which the leaching field will be located. Mechanical design responsibility will include coordination of piping, pump, chlorination, and valve locations with a suitable tank location.

c. Other treatment facilities. Facilities other than septic tanks will normally be a civil engineering responsibility and will involve one of several types of secondary on tertiary treatment processes. Mechanical design responsibility will include piping, valves, pumps, ejectors, chlorination, and coordination.

d. Nongravity sewage. Where it is impractical to move raw sewage from the powerhouse collection point to the treatment facility by gravity flow, a duplex pneumatic sewage ejector or duplex nonclog centrifugal pumps capable of passing a 51-mm (2-in.) sphere should be provided. Duplex nonclog pump installations require the following: all sewage to be screened before entering the sump pump, the screen to be self-cleaning with each pump operation, pumps to be of the wet pit type, automatic interchange of the operating and off pumps on every start, and each pump capable of handling rated system inflow. These requisites can be accomplished by connecting the inflow line from the powerhouse sanitary system into the pump discharge lines with commercially available equipment and collecting the solids on the discharge line screen of the off pump while the liquids are backed through the off pump to the sump. The subsequent pump operation will clear the screen. Valving, screens, and interconnections should follow manufacturers' recommendations. The smallest capacity pneumatic sewage ejectors and nonclog pumps tend to be higher than the required capacity for most powerhouses, and the specifications should permit

the contractor the option of supplying either ejectors or nonclog pumps.

e. Sludge and effluent provisions.

(1) General. Effluent will be pumped via fixed piping to leaching fields or, in the case of approved secondary or tertiary treatment plants, may be pumped or discharged by gravity to tailwater through an underwater discharge. Sludge will normally be pumped via fixed piping to a deck hose valve accessible to trucks. Minimum line size should be 80 mm (3 in.).

(2) Pumps. Sludge and effluent pumps should have not less than a 40-mm (1.5-in.) inlet and outlet and should pass a 25.4-mm (1-in.) sphere. Where both effluent and sludge pumps are required for the same treatment plant or septic tank, it is preferable to provide identical pumps to allow each pump to serve as backup for the other. Backup operation is temporary only and should be provided for by hose and hose valves, tied to the suction and discharge piping of each pump rather than fixed piping. Alternate backup provision is a spare pump and piping connections suitable for rapid exchange of pumps. Control of effluent pump should be automatic and provided by either float or bubbler control. Control of sludge pumps should be manual and should include an adjustable timer switch to limit pump operation to the normal sludge pumping time requirement.

(3) Line losses. Pumping head computations for sludge pumps should reflect the higher line losses due to entrained solids. Computing overall losses on basis of water and using a multiplying factor of 2.5-3 will be satisfactory for most powerhouse applications. If velocities exceeding 1.5 m/s (5 fps) are encountered, the factor may be reduced to 1.5.